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The Evolving Western Water Markets

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Expanding population and environmental protection the world over are placing additional demands on existing water supplies. Meeting these demands by traditional structural supply augmentation is dogged by increasing environmental and fiscal costs, which leave excess water demand to be met largely by conservation and reallocation of existing supplies. Water trading clearly has a role in reallocating supplies and stimulating conservation by providing a clear measure of its value for conservation and a voluntary self-compensating mechanism for reallocation. Despite these advantages, traditional markets have been slow to evolve in the western United States for institutional and hydrologic reasons. However, even when institutional, political, and physical impediments prevent textbook water markets from developing, significant gains in efficiency can result from relaxing restrictions on ownership, use, and transfer. Most water markets in the western United States fall between the two extremes of textbook markets in which, on the one hand, price is determined by unfettered market forces, and on the other, there is an outright legal prohibition of trading.

Three fundamental reasons probably cause the slow evolution of water markets in the West. First, water has many *public good* characteristics, benefiting not only the owner of a water right, but also the public at large. Public interest in water is supported by the fact that most western states retain the ultimate property right to water; individual water rights are more akin to use rights than private property rights. Second, fluctuations in water supply result in periodic "thin" markets with few participants. Third, water transfers often require significant costs, in terms of both institutional costs and the cost of physically transporting the resource. Even in the presence of willing buyers and sellers, trades of permanent water rights are often not approved by regulators because they would result in significant *externalities*—physical impacts on parties not involved in the transaction—and in third party financial impacts to the exporting region.

A worldwide survey of existing markets makes it clear that gains in efficiency can occur even in the absence of theoretically perfect markets (Saleth & Dinar, 2004). The efficiency gains are achieved by moving water to higher value uses. To achieve these gains, many states west of the Mississippi River have implemented legislation to facilitate water trading within their borders. However, because water has both private and public good characteristics, it has often been developed with some degree of public financing or subsidies. Hence, its reallocation generates heated controversy—especially when potential profits are involved.

Water Market Determinants

What factors determine whether and how markets develop? Why is trading heavier in some states than in others? The importance of water's physical characteristics cannot be emphasized enough. In many parts of the West, the water supply is uncertain; there is tremendous temporal and spatial variation in rainfall. Furthermore, supply and demand peaks do not generally coincide within the water year. For example, when snow pack melts in the spring, it is stored in surface reservoirs until late summer when farmers' irrigation demand peaks. These fundamental characteristics of precipitation make water market development all the more desirable, but they hinder the creation of markets in the first place. Transportation and storage facilities have been constructed throughout the West, largely at public expense, to convey water across time and space. Not surprisingly, water markets have tended to develop in locations where the Bureau of Reclamation and state water projects have invested resources in creating an infrastructure to facilitate the transportation and storage of water.

Yet obstacles remain. Even though water garners substantial political attention and controversy, its economic value at the margin is actually quite low relative to the cost of conveyance. For example, the option purchase price for

water in a 2002 transaction between Glenn-Colusa Irrigation District in northern California and the Metropolitan Water District serving the Los Angeles area was $110/acre-foot. The cost of transport (including a mandatory 20% environmental mitigation requirement and 300-mile transport and pumping fees) is approximately $143/acre-foot, for a total delivered cost of $253/acre-foot. Such high transaction costs reduce the number of trades that are financially viable and the geographical scope of markets.

Water's mobility also makes property rights enforcement a challenge. Property rights are easier to monitor in some settings than others. For example, annual fallowing transfers from rice growers in the north of California to urban users in the south of California are relatively easy to monitor. If the fields are fallowed, the water must still be in the river and presumably flows to the purchasers. In contrast, monitoring sales of water saved by more efficient field application methods requires the detailed assessment of current and past irrigation technologies as well as the level of implementation.

For trades to occur easily, property rights must be clearly defined, enforceable, and transferable. In most western states, water property rights are governed by prior appropriation, whereby the first to claim the water in a waterway for beneficial use has first priority to the water, and a water right not exercised for a period of some years is relinquished. When appropriative rights were codified into state laws in the late 19th and early 20th centuries, state lawmakers did not envision widespread leasing and permanent transfers of water rights. As a result, western rights holders have historically been reluctant to lease water out, for fear of losing their right to the water in the longer term. Further, permanent transfers of water rights under prior appropriation have usually been costly and time-consuming. Permanent transfers and leases have recently become easier, as state laws have changed to facilitate market transactions.

One water market in the West where property rights are clearly defined, enforceable, and transferable is a Bureau of Reclamation project on the eastern slope of the Rocky Mountains: the Colorado-Big Thompson (CBT). Water rights in the CBT are correlative; shares fluctuate annually in response to water conditions, and all shareholders benefit or lose each year in like manner. The shares are entirely homogeneous, and transfer occurs with minimal fees and paperwork. However, the CBT system has the great advantage of using water imported from another watershed, thus freeing it from the impacts of reduced or altered flows on downstream users or externalities that complicate water trades along natural rivers. In contrast, California water rights are far from homogeneous. California continues to recognize riparian rights (water rights that are attached to the land adjacent to the waterway) alongside appropriative rights, which makes defining water rights with sufficient precision to sell them costly and litigious (Carey & Sunding, 2001). Furthermore, in many parts of California (as elsewhere in the West), federal ownership of developed water resources complicates market development.

The differential in water values between current owners and potential buyers is often great enough to stimulate potential trades. However, another complexity is the physical and environmental externalities intrinsic to trading an environmental resource. Reduced or altered flows on a waterway affect water quantity and quality downstream. Drawdown in an underground aquifer affects neighbors' pumping costs. Such externalities may be positive or negative. When they are negative, there is a role for regulatory agencies to ensure that nonmarket values placed on the waterways by society are taken into account. The absence of adequate protections for those adversely affected by negative externalities may result in trade volume that exceeds the socially efficient level. On the other hand, these concerns have traditionally been handled through lengthy court procedures, which may discourage socially beneficial trading. Over time, regulatory agencies should develop procedures to address these issues in a less costly manner, perhaps through the development of a body of precedent cases to guide water traders and through the standardization of environmental impact reports.

Although water trades may increase overall efficiency within a market, there can be negative financial impacts on third parties in the area of origin through local loss of income and employment and through impacts on neighboring groundwater users. Trades are more likely to occur where impacts on third parties in the area of origin are minimal (perhaps because the water does not leave the watershed in which it originates) or where state law does not recognize them. Standard economic theory does not usually consider these third-party financial losses to be legitimate. However, many trades do provide some compensation to third parties, often to appease public opinion. This concern for third-party financial losses results from fundamental water property rights. In most of the west-

Table 1. Volume and volume-weighted prices for reported water transactions, 1999–2002.

	Volume (thousand acre-feet)				Price ($/acre-foot, in 2004 dollars)	
State	Lease	Sale	Total	Lease/sale ratio	Lease	Sale
AZ	1,371	24	1,395	53	73	894
CA	3,127	227	3,354	14	80	1,207
CO	74	242	316	0.3	22	3,451[a]
ID	692	1	693	692	10	201
KS	4	0.2	4.2	20	51	—
MT	5	—	5	—	5	—
NM	338	10	348	34	66	1,233
NV	—	49	49	—	—	2,572
OK	10	—	10	—	59	—
OR	532	38	570	14	283	1,045
TX	877	322	1,199	3	81	864
UT	6	3	9	2	6	870
WA	68	13	81	5	53	513
WY	105	—	105	—	40	—
Total	7,211	929	8,140	8	86	1,299

[a] CBT sales omitted. If included the average sale price is $7,801.
Source: Data from the Water Strategist. The authors acknowledge Adams, Crews and Cummings (Georgia State University) for generously providing us with their database of Water Strategist transactions; and Alex Lombardi for assistance.

ern states, the ultimate owner of the water is the state itself, which is bound to protect the welfare of its citizens.

Externalities and third-party damages are likely to become more important as a greater volume is traded. Thus, we expect that these pressures will induce a higher percentage of leases relative to permanent sales, as negatively affected parties exert political pressures in regulatory arenas to limit permanent transfers. Examination of columns four and five in Table 1 suggests that states where more volume is traded have a higher lease-to-sale ratio. This tension between the benefits to trading partners and the negative effects on third parties is likely to be the dominant influence on future trading patterns.

What Do Existing Water Markets Look Like?

We were unable to find public source of consistent data on western water trading, so we compiled a summary of trading from fourteen western states for 1999–2002 from back issues of the *Water Strategist.* Although the *Water Strategist* may not record all the trades in western water, it is the only comprehensive source of water trade information. If there is a selection bias in the reported trades, it should be consistent across states and thus not influence the comparisons. We classified the trades as *sales* and *leases*. In a permanent sale, the right to the water for all time is transferred. Lease transactions involve short-term trades of water; the underlying property right remains unaffected by the transaction. Table 1 shows that water leases dominate the market in terms of water volume traded. Permanent sales comprise approximately 10% and leases 90% of the volume traded, although it is important to remember that a permanent water rights sale only appears once, whereas a lease is often an annual contract that must be renewed each year to reflect the same quantity of water over the long term.

A majority of the trades reported in the *Water Strategist* are from agricultural sellers to urban buyers who are grappling with projected increases in demand. In Colorado and New Mexico, municipal agencies are purchasing permanent rights and leasing them back to the irrigators from whom they purchased in the first place until needed to meet anticipated future demand. The *Water Strategist* data suggest that water purchases for municipal and industrial use trade at higher prices than water for agricultural or environmental use.

Market purchases for environmental use have increased in recent

years. In California, for example, direct purchases such as those made by state and federal entities to comply with federal environmental regulations (primarily augmenting stream flow to enhance fish runs) accounted for one third of traded volume in 2001. By contrast, municipal buyers only accounted for about 20% of market activity (Hanak, 2002). This trend is repeated elsewhere in the West. In the Pacific Northwest, for example, water market development has been driven by the need to acquire water for environmental purposes (Smith, 1995).

The sale prices reported in the *Water Strategist* in Colorado, Nevada, and New Mexico over the survey period are markedly higher than in other states, probably reflecting the relative scarcity of the resource in these locations. Financial theory would suggest that the price of a right would exceed the capitalized value of a lease for two reasons. First, the purchase of a right eliminates the risk inherent in relying on future lease markets. Second, given the uncertainty of the value of future water rights, rational sellers would require a premium or hurdle rate in addition to the capitalized value of current leases to consummate the deal. A counterpoint to the risk argument is that leases are more likely to be concentrated in years of greater scarcity, whereas the return from the sale of a right should be averaged over all types of water year.

The lease-to-sale price ratios in Table 1 give us the implicit capitalization rate over an infinite planning horizon, which averages 6.6%. This is below the standard commercial capitalization rate of 10%, but it seems a reasonable rate given the risk reduction from permanent sales. It is also worth noting that high-volume states, such as Arizona and California, have rates close to 6.6%, whereas low-volume states exhibit tremendous variation in their implicit capitalization rates. The variation is likely due in part to thin markets with few buyers and sellers.

Permanent Sales, Leases, and Options

One striking aspect of the descriptive statistics provided in Table 1 is the dominance of leases in 12 of the 14 states. Permanent trading is only clearly dominant in the dry states of Nevada and Utah, where diversions and permanent trading have always been an integral part of settlement and development.

In the presence of supply uncertainty, many water agencies in the West seek to purchase water only in dry years when their own supplies are inadequate. This may explain trading behavior in Idaho, Oregon, and Washington, where most water transfers are leases for environmental and (to a lesser extent) agricultural use. Such leases may be in response to annual water year conditions. A water rights transfer would be an appropriate response to permanent shortage rather than the year-to-year supply uncertainty which often prevails. In short, leases are common because temporary transfers of one year or less face significantly fewer environmental regulations, the costs of defining rights sufficiently to sell them permanently are often prohibitive, and the presence of sufficient supply in wet years makes permanent transfers unnecessary and costly in many cases.

A specific type of leasing—the *option agreement*—is gaining currency in California. Under an option agreement, the purchaser pays an option cost in the fall before the winter precipitation for the right to purchase a specific quantity of water in the spring, should the water year turn out to be dry. By paying the option cost, the buyer manages supply risk by avoiding last-minute spring contract negotiations for water, which may no longer be available at a reasonable price. Buyers can further decrease transaction costs by negotiating long-run, multiple exercise options. The benefits of options are twofold.

First, the water remains in the basin of origin during average and wet water years, lowering third-party financial impacts and making it more likely that regulators will approve the transfers. Options undertaken due to the burdensome regulatory requirements of permanent transfers are second best from an economic efficiency perspective, but are preferable nonetheless to no trades at all. Second, given supply and demand circumstances in California, this is an efficient arrangement of property rights and uses. In California, a typical trade might be between small water rights holders in the North with low-value agricultural use and a large municipal water agency in the South with relatively high-value use. Because the municipal agency has a relatively high-value use but sufficient developed supplies during wet and normal years, the water is most efficiently allocated to the municipal user in dry years and the agricultural farmers in wet and normal years.

Who should own the water to best ensure efficient allocation between dry and wet years? If we assume for simplicity that the transaction costs are the same regardless of who owns the water, then the water right should remain with the low-value agricultural use, so that transaction costs are a lower proportion of the buyer's final sale price. If transaction costs vary depending on who

possesses the water right (small buyers may collectively face higher bargaining costs than a single large buyer), this further strengthens the case for low-value users to retain their water rights.

An option agreement negotiated in advance of the water year helps the municipal agency manage its supply uncertainty. If the difference in value between the buyer and sellers is larger than the transaction costs, the agricultural rights holders can be sufficiently compensated for this dry-year option contract. To the extent that western states will have to increase water trading to balance demands, and third-party pressures increase, we expect the proportion of option contracts to increase.

Water Markets in the Future

Markets as a mechanism for water allocation are gaining traction in the western United States. However, concern over environmental and economic externalities and third-party impacts in exporting regions will continue to be issues with which developing markets must contend. These institutional impediments to water transfers, combined with the uncertainty of water supply, will probably lead to a proportional increase in the number of lease transactions relative to permanent sales of water rights. In particular, the risk-sharing characteristics of option agreements correspond precisely to the need for flexibility in those instances where supply risk is shared by both parties or where it is possible to sell risk between parties.

For More Information

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